

IN THE SPECIFICATION

Please replace the paragraph at page 2, lines 12-24, with the following rewritten paragraph:

Material producers, such as producers of pulp, paper, and board, are facing a rapidly changing world. They must meet increasing customer demands for ~~[[a]]~~ specific grades in smaller batches. Products must meet quality demands specified within narrow limits. The increased environmental awareness is met by large efforts, not only to meet the more stringent demands and regulations set on their activity, but also to ~~minimise~~ minimize the impact of their influence on the environment. Increased recycling within the production process as well as an increased use of reclaimed matter as raw material or additions to the process also put higher demand of the control and supervision of process. Additionally, these producers face a tougher competition, which can only be met with high-quality products.

Please replace the paragraph at page 3, lines 1-14, with the following rewritten paragraph:

For processes containing two or more unit processes, an overall ~~optimisation~~ optimization of the process is required. The ~~optimisation~~ optimization of the process includes an ~~optimisation~~ optimization of, for example, the product quality, the total economy, environmental aspects, energy consumption, maintenance of product equipment, etc. A typical example of an ~~optimisation~~ optimization is an ~~optimisation~~ optimization of the process in order to find optimal set-points for pumps, valves, etc. in the process to achieve a certain production volume during a given period of time under the given conditions. Thereby, the ~~optimisation~~ optimization includes the downloading of tank levels, temperatures, etc. on-line from a process computer system into a computer, and using the

downloaded values together with algorithms adapted for the ~~optimisation~~ optimization and control of the process.

Please replace the paragraph at page 3, lines 16-27, with the following rewritten paragraph:

Normally, the values of a plurality of variables in the process will be measured by means of sensors and used as input to the algorithms for the ~~optimisation~~ optimization and control of the process. However, every now and then, such measurements will be incorrect due to the malfunctioning of the sensors. Some deviation between measured values and the predicted or real values of the variables in question can be tolerated, but when the error is above a certain level due to the malfunctioning of a sensor, that value should not be used in the ~~optimisation~~ optimization algorithm or in the control model of a control system, and the sensor in question should be replaced or repaired in order to make it possible to provide the control system with correct measurements.

Please replace the paragraph at page 3, lines 29-33, with the following rewritten paragraph:

Therefore, prior art has proposed different ways of tracking, identifying, and ~~analysing~~ analyzing the malfunctioning or defective sensors. Prior art also suggests ways of tracking, identifying, and ~~analysing~~ analyzing a malfunctioning or defective actuator or controller, or production unit or device.

Please replace the paragraph at page 4, lines 21-26, with the following rewritten paragraph:

This object is achieved by means of the initially defined method, which is ~~characterised in that it~~ comprises the further step of executing an automatic ~~diagnose~~ diagnosis of the validity of the process data retrieved from the process for the purpose of preventing irrelevant process data from being used as input in the control model.

Please replace the paragraph beginning at page 4, line 28, through page 5, line 3, with the following rewritten paragraph:

Preferably, the process is simulated by means of a separate process model which updates the control model and provides it with set point values for its operation. Preferably, the process is ~~optimised~~ optimized by means of the process model which, with given constraints, will provide the control model with suitable set point values for said ~~optimisation~~ optimization with regard to different issues, such as total economy, environmental aspects, product quality, maintenance of process equipment, etc. Preferably, the process model is adapted to modify or replace essential parts of the control model upon reception of certain information, in particular information concerning irrelevant process data that should not be used for the operation of the control model.

Please replace the paragraph at page 5, lines 5-16, with the following rewritten paragraph:

According to the inventive method, the process model is provided with process data from the process, the operation of the process model being based on said process data. At least some of said process data is retrieved from the process by means of sensors for in-line, on-line and/or at-line measurement, for example the same measurements as those used as

input to the control model. Preferably, the process model is provided with information from the ~~diagnose~~ diagnosis for the purpose of preventing irrelevant process data from being used as input in the process model. Hence, the process model, as well as the control model, is continuously upgraded on-line in order to prevent it from using incorrect or irrelevant process data for its operation.

Please replace the paragraph at page 5, lines 18-30, with the following rewritten paragraph:

The present invention should provide a computer based method and system which ~~devise~~ devises a way of diagnosing the performance of sensors in a process, so that the accuracy of the measurements made by said sensors can be validated. The system and method according to the invention should also be adapted as to provide information about the relevance of certain measured values of process variables in order to make it possible to automatically decide whether certain measured values should or should not be included in models for the overall ~~optimisation~~ optimization and control of the process, and for the purpose of making it possible to decide whether a certain sensor should be repaired or replaced due to malfunctioning. The same applies for defective or malfunctioning process equipment in general.

Please replace the paragraph beginning at page 5, line 32, through page 6, line 5, with the following rewritten paragraph:

According to the invention, the above object is achieved by the initially defined method, in which ~~is characterised in that~~ the automatic ~~diagnose~~ diagnosis comprises the steps of executing at least two predictions of a given process variable with different sets of measured variables as input to a model for executing said predictions, observing any

deviation between the predicted values and the measured value of said process variable, and evaluating the observed deviation pattern for the purpose of deciding whether the measured value of said variable should or should not be used as input in the control model and/or the process model.

Please replace the paragraph at page 6, lines 8-27, with the following rewritten paragraph:

Alternatively, the above object is achieved by the initially defined method, which is ~~characterised in that~~ it comprises the further steps of measuring a value of at least two process variables at at least one location in the process, predicting said at least two variables by means of a model for a relevant part of the process, with given boundary conditions, observing any deviation between the measured and predicted value of each process variable, and comparing and evaluating the observed deviations for the purpose of deciding whether the measured values of said variables should or should not be directly used as input to the control model and/or process model. Preferably, each prediction is based on a certain set of input data, i. e. measurements, excluding the measured value of the variable to be predicted. If the values of two variables are measured and predicted, and the measured variables deviate in the same, but acceptable way from the predicted values, it is reasonable to make the conclusion that the sensors for measuring are functioning. If, on the other hand, one of the deviations differs remarkably in any way, then one cannot be sure which of the sensors is malfunctioning, or if there is any other disturbance in the process affecting the measured value.

Please replace the paragraph at page 8, lines 12-21, with the following rewritten paragraph:

The process variables, the values of which are measured and predicted can be concentrated to one and the same unit process. However, when the process, and an automatic diagnostic system built thereon, is more developed, the values of process variables in more than one, preferably all unit processes are measured and predicted. The values, the deviations of which are compared to each other are normally measured in one and the same unit process. However, as an alternative, deviations or process variables measured in different unit processes are executed in certain cases when this is found advantageous for the ~~diagnose~~ diagnosis.

Please replace the paragraph beginning at page 8, line 23, through page 9, line 3, with the following rewritten paragraph:

The inventive method includes a simulation and an overall ~~optimisation~~ optimization of the process, said simulation and ~~optimisation~~ optimization being based on information concerning the result of said measurements and predictions of the process variables, the comparison of the deviations, and the observation of individual sensor malfunctioning, equipment malfunctioning, and/or process disturbances. The simulation and ~~optimisation~~ optimization are executed by means of one or more algorithms as described earlier in this application. The process is ~~optimised~~ optimized with regard to any one or a combination of issues such as product quality, economy, environmental aspects, energy consumption, and maintenance. The maintenance ~~optimisation~~ optimization preferably concerns when certain sensors and certain process equipment should be repaired or replace. The simulation and ~~optimisation~~ optimization serve to set the set-points for a plurality of variables in the process

with regard to what is being ~~optimised~~ optimized. Here, the simulation and ~~optimisation~~ optimization is executed by the process model, which applies set-points to the control model.

Please replace the paragraph at page 9, lines 5-16, with the following rewritten paragraph:

The invention also comprises the use of so-called soft sensors. Such soft sensors could include models for predicting certain product qualities based on certain process variable values. In the case of a process for the production of pulp and paper, the soft sensing could include the prediction of, for example, paper strength based on the measurement of ~~fibre~~ fiber size, distribution, NIR spectra, refiner energy input, and the like. Thanks to the inventive method, based on which an automatic diagnostic system can be built, such soft sensing can be more reliable. Preferably, the soft sensing plays a vital role for the ~~optimisation~~ optimization of the process, for example for the ~~optimisation~~ optimization with regard to the product quality.

Please replace the paragraph at page 9, lines 27-32, with the following rewritten paragraph:

The invention also refers to a computer based system as initially defined, which is ~~characterised in that it~~ comprises means for executing an automatic ~~diagnose~~ diagnosis of the validity of the process data retrieved from the process for the purpose of preventing irrelevant process data from being used as input in the control model.

Please replace the paragraph beginning at page 9, line 34, through page 10, line 9, with the following rewritten paragraph:

The ~~diagnose~~ diagnosis means comprises measuring means that comprise sensors for in-line, on-line and/or at-line measurement. It also comprises predicting means, observing means, and means for comparing and evaluating the observed deviations, said means preferably being arranged as software in a computer. The inventive system also comprises means arranged as a software in a computer for executing all other steps of the inventive method as defined above. Accordingly, the inventive system comprises a system for automatic ~~diagnose~~ diagnosis of the process in question. It may also comprise empirical models or algorithms for the ~~optimisation~~ optimization of the process based on information from the automatic ~~diagnose~~ diagnosis system.

Please replace the paragraph and subparagraphs at page 10, lines 17-27, with the following rewritten paragraph and subparagraphs:

Hereinafter, the invention will be described by way of example with reference to the annexed drawings, ~~on~~ in which:

Fig. 1 is a schematic flow chart showing the essential ingredients in the inventive method and system,

fig. 2 is a more detailed, but still schematic flow chart of a ~~diagnose-means~~ diagnosis system according to the invention,

figs. 3a-c are examples of deviation patterns observed and treated by the ~~diagnose means~~ diagnosis system, and

fig. 4 is an example of a deviation pattern observed and treated in an alternative way by the ~~diagnose-means~~ diagnosis system.

Please replace the paragraph at page 11, lines 17-25, with the following rewritten paragraph:

According to figs. 1 and 2, the system also comprises means 11 for executing an automatic ~~diagnose~~ diagnosis of the validity of the process data retrieved from the process P by the measuring means 2-8 for the purpose of preventing irrelevant process data from being used as input in the control model 1. The ~~diagnose~~ diagnosis means 11 will be explained more in detail later with reference to fig. 2. However, one of its main tasks is to prevent process data retrieved by malfunctioning sensors from being used as input in the control model 1.

Please replace the paragraph beginning at page 11, line 27, through page 12, line 2, with the following rewritten paragraph:

The system also comprises a separate process model 12 for simulating the process. The process model 12, arranged as software in a computer, may include one or more physical models and/or empirical models for simulating the process. The process model 12 is adapted to update the control model 1, or, more precisely, provide the control model 1 with set point values for its operation. The set point values are set point values for different process variables or parameters. The process model 12 is adapted to simulate and ~~optimise~~ optimize the process P with regard to one or more of a plurality of issues, such as product quality, process economy, environmental aspects, etc., with given constraints.

Please replace the paragraph at page 12, lines 4-13, with the following rewritten paragraph:

The system also comprises means 2-8, shown in fig. 2, for providing the process model with process data which is used by the process model 12 for its operation. Said means

2-8 include a plurality of sensors, preferably arranged for in-line or on-line measurement of a plurality of process variables. According to the invention, the ~~diagnose~~ diagnosis means 11 is adapted to provide the process model 12 with information for the purpose of preventing irrelevant process data from being used as input in the process model 12. Typical such irrelevant or incorrect process data is process data delivered from malfunctioning sensors.

Please replace the paragraph at page 12, lines 15-17, with the following rewritten paragraph:

The ~~diagnose~~ diagnosis means 11, shown in detail in fig. 2, plays a vital role in the system, and will therefore be described more in detail hereinafter.

Please replace the paragraph at page 12, lines 19-28, with the following rewritten paragraph:

The ~~diagnose~~ diagnosis means 11 comprises a model 13 for predicting the values of two or more, preferably a plurality of process variables  $\hat{Q}_i, \hat{T}_i$  corresponding to the variables the state or values of which are measured by means of said means or sensors 2-8. For this purpose, the predicting model 13 is supplied with process data from the means 2-8.

However, when the predicting model 13 predicts the value, for instance  $\hat{Q}_i, \hat{T}_i$  of a certain variable, it executes its prediction without regard to the measured value  $\hat{Q}_i, \hat{T}_i$  of that specific variable. The predicting model 13 will be discussed more in detail later.

Please replace the paragraph at page 14, lines 17-24, with the following rewritten paragraph:

Based on the result of its evaluating operation, the evaluating means 17 is adapted to provide information concerning malfunctioning sensors or process disturbances or errors to the control model 1 and the process model 12, respectively. Accordingly, the ~~diagnose~~ diagnosis means 11 defines an advanced, automatic ~~diagnose~~ diagnosis system used for the purpose of preventing incorrect process data from being used as input in the control model 1 and the process model 12.

Please replace the paragraph beginning at page 14, line 26, through page 15, line 2, with the following rewritten paragraph:

According to the embodiment shown in fig. 2, the measured process data are divided into a plurality of groups, and a deviation pattern is observed for each group. Every group has at least one process variable common with another group. In fig. 2, this is indicated by the variables measured by the measuring means 4 and 6. By gathering the measured process data in different groups with predetermined data common for different groups, individual deviation patterns for each group can be observed by the means 14, 15, 16, and then handled by the evaluating means 17. By dividing the process data in groups in the described way, the deviations are presented to the evaluating means 17 in a way which promotes an efficient ~~[[an]]~~ and reliable analysis by the evaluating means 17.

Please replace the paragraph at page 16, lines 14-23, with the following rewritten paragraph:

Thanks to the invention, it will be possible to do on-line prediction of non-measured properties in a line for production of pulp and paper. Such properties could be yield, fibre

fiber or paper strength, bleachability, etc. It will be possible to measure different in-line and on-line properties, and correlated to lab measurements of the actual properties. The analysis of the reliability of these predictions can then be made by this signal check, as outlined above. New empirical models can be constructed where only reliable data can be identified automatically, without having to do a lot of manual checks.